Net Metering and Interconnection

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(excerpted from work done by Tom Starrs under contract to the Solar Electric Power Association (SEPA))

Overview

- Integrating small-scale Renewable or Clean (Fuel Cell, small wind, or PV) distributed generation systems into the utility grid depends on the ability of consumers to purchase, install, and interconnect these systems easily.

- Three sets of issues need to be addressed:
  - Metering options (dual metering vs. net metering)
  - Technical requirements for interconnection (safety and power quality issues); and
  - Non-technical requirements for interconnection (contractual, economic and legal issues).

Terms and Conditions for Interconnection

- May involve the following:
  - Metering options
  - Size restrictions on metering options
  - Carryover credit on monthly billings
  - Net Meter or differing buy and sell rates
  - Outdoor disconnect requirements
  - Insurance requirements
  - Interconnection costs

Metering Issues

- Metering policies determine the "value" we place on the energy that flows through an electric meter.
- Metering policies can be used to *encourage* clean and renewable energy investments by increasing the effective rate of return.
- 33+ states now require *net metering* for certain small-scale renewable energy systems, with additional proposals pending in additional states and in Congress.
- Other metering options enable the establishment of 'green pricing' programs that pay a premium for 'green' resources

What Is Net Metering?

- Allows customers to use excess renewable generation to offset utility-purchased electricity on a *periodic* basis (usually a monthly or annual period);
- Effectively values all renewable generation (up to parity) at retail rates; any excess generation is sold at the lower 'avoided cost' rate, or is uncompensated;
- Most electricity meters used in residential and small commercial applications are *bi-directional*, making net metering easy to implement without meter replacement.

Benefits and Costs of Net Metering

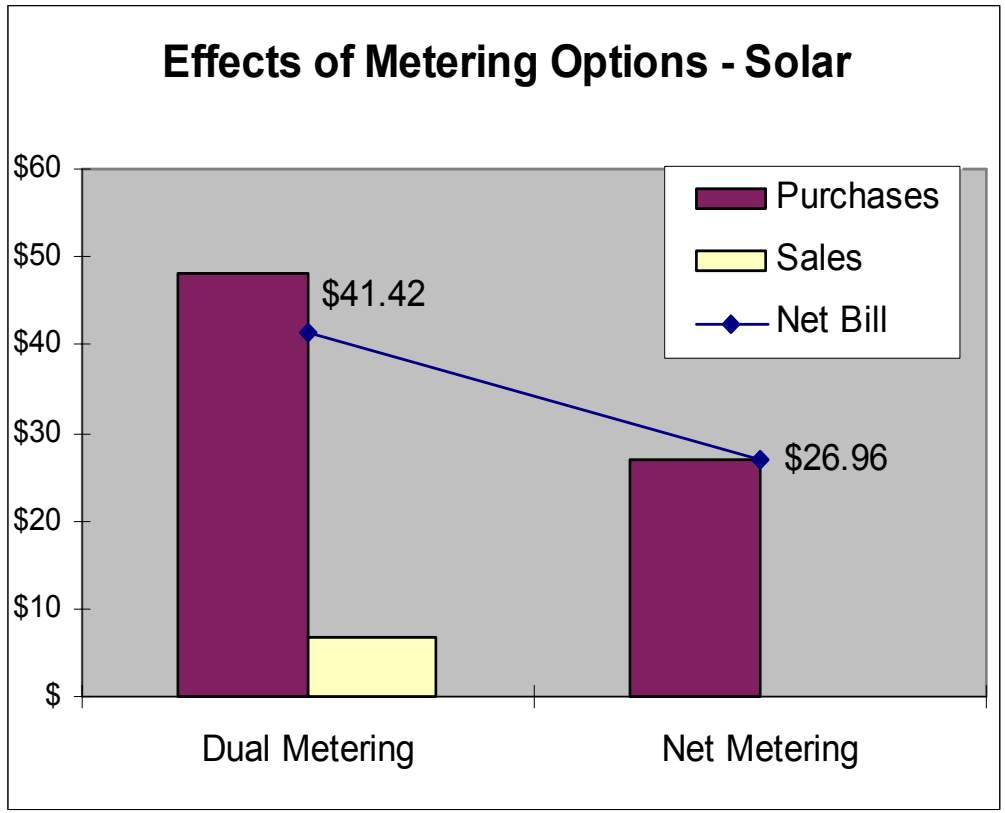
- Benefits:
  - Encourages direct customer investment in small-scale renewable energy systems;
  - Simplifies interconnection by avoiding meter replacement;
  - Improves economics of small-scale renewables;
  - Reduces metering and administrative costs for utility.

- Costs:
  - Exacerbates the revenue loss from self-generation
  - Makes tracking of customer's energy flows difficult (unless a dual-register meter or dual meters are used)

Effects on Utility Bill w/ Solar PV

Assumptions:

- 2 kWp solar PV System
- PV system generates 263 kWh/month
- Residence uses 600 kWh/month
- Retail price: $0.08/kWh
- "Avoided cost" price is $0.025/kWh



Source: Tom Starrs

Making Net Metering Viable

- Use of program 'cap' and other size and technology constraints to limit scope of program to a level that is manageable for utilities;
- Avoid excessive standby charges and other fees, which can offset the economic benefits of net metering;
- Pro-actively address issues of net metering implementation in retail access environment.

Utility Interconnection Issues

- Personnel safety
- Equipment protection
- Service reliability
- Power quality

Interconnection: Technical Issues

- The Problem:
  - Utilities are responsible for maintaining the safety and reliability of the grid, and have legitimate concerns about the interconnection of equipment to the network.
  - BUT, utilities face a conflict of interest because they have an incentive to discourage self-generation by customers.
- The Solution:
  - Uniform adherence to codes and standards developed by nationally-recognized independent authorities, such as IEEE, UL, and NEC.

Utility Interconnection Requirements

- IEEE standard 929 (PV)
- IEEE standard 1547 (Distributed Generation)
- UL standard 1741
- Utility practice and requirements
- Public utility commission statutes

IEEE 929-2000

- Passed by IEEE Standards Board in January, 2000.
- Represents an excellent primer on PV inverter interconnection issues.

P929
Recommended Practice for Utility Interface of Photovoltaic (PV) Systems

Prepared by the Utility Working Group of
Standards Coordinating Committee 21, on Photovoltaics

UL 1741 Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems

- First released May,1999
- Has been revised to match IEEE 929-2000
- Compliance with revised document required on November 7, 2000)
- New title reads “Standard for inverters, converters, and controllers for use in Independent Power Systems.”(Nov 8)

Underwriters Laboratories Inc.®

Subjects 1741

333 Pfingsten Road
Northbrook, IL 60062
March 3, 1999

TO: Industry Advisory Group of Underwriters Laboratories Inc. for Power Conditioning Units for Use in Residential Photovoltaic Power Systems,
Electrical Council of Underwriters Laboratories Inc.,
Subscribers to UL's Listing Services for Photovoltaic Charge Controllers (QIBP),
Subscribers to UL's Listing Services for Photovoltaic Power Systems Accessories (QIIO),
Subscribers to UL's Listing Services for Power Conditioning Units for Use in Residential Photovoltaic Power Systems (QIKH), and
Subscribers to UL's Listing Services for AC Modules (QHYZ)

SUBJECT: Request for Comments on the Proposed First Edition of the Standard for Static Inverters and Charge Controllers, UL 1741; PROPOSED EFFECTIVE DATE

Attached as Appendix A for your review and comment are proposed requirements for UL 1741. Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix B of this bulletin regarding designated responsibility for the subject product categories.

Please note that proposed requirements are of a tentative and early nature and are for review and comment only. Current requirements are to be used to judge a product until these requirements are published in final form.**PROPOSED EFFECTIVE DATE**

The proposed requirements will necessitate a review and possible retest of currently Listed products. Therefore, UL proposes that the new requirements become effective 18 months after publication. This is intended to provide manufacturers with sufficient time to submit modified products for investigation and to implement the necessary changes in production. Please note that this also includes the time that will be needed by UL to conduct a review of the modified product.

RATIONALE

The first edition of the Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems, UL 1741, was proposed in the subject bulletin dated August 1, 1997. The proposed Standard has been significantly revised since then. The revisions are a result of the comments UL received from industry members regarding the proposed draft. In addition, the revisions were made to align the proposed Standard with the Ninth Draft of Recommended Practice for Utility Interface of Photovoltaic (PV) Systems, P929, and other UL Standards. This bulletin proposes the revised first edition of the Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems, UL 1741.

What is UL 1741 and how does it relate to IEEE 929?

- First official version published in May of 1999. “Final” version released November of 2000.
- 1741 incorporates the testing required by IEEE 929 (frequency and voltage limits, power quality, non-islanding inverter testing)
- 1741 testing includes design (type) testing and production testing.
- Line-tie inverters should have the words **“Utility-Interactive”** printed directly on the listing label—this makes identification of the listing much more straightforward (several inverter manufacturers currently using this designation).

Standards Are Developed

- Standards have been finalized for PV technology:
  - NEC Article 690 addresses wiring and installation of PV systems
  - IEEE 929-2000 addresses utility interconnection of PV systems
  - UL 1741 addresses performance and testing requirements for static inverters and charge controllers used in PV systems
- Standards are available (IEEE 1547-2003) for other distributed technologies, including wind turbines, fuel cells, gas turbines, and energy storage

DG Technical Standards Adoption

- Over a dozen states have adopted -- or are committed to adopting -- interconnection standards based on UL/IEEE
- These states are: CA, DE, MD, MT, NJ, NM, NY, OH, OR, RI, VT, VA, WA
- A number of additional states are addressing PV interconnection standards
- States have started addressing interconnection standards outside of the net metering context -- very important for larger DG applications not eligible for net metering

Adoption Is *Not* Implementation

- Streamlining interconnection involves three essential steps:
- *Development* of standards => DONE!
- *Adoption* of standards => IN PROGRESS . . .
- *Implementation* of standards => STILL TO COME . . .
- Example -- California: *Implementation* required nearly five years, and required the repeated intervention of the legislature, the PUC, the CEC, CalSEIA and other stakeholders

Expanding Adoption Efforts

- The good news: the "templates" are in place
- The bad news: lots of work remains to be done!
- Many states have net metering but *have not* adopted national technical standards
- Many states have adopted standards for small-scale DGF but *have not* adopted simplified standards for larger DG systems
- Proposals for adoption of national technical standards are beginning to surface

Interconnection: Non-Technical Issues

- Customers seeking to interconnect a 2 kW PV system or a 10 kW wind turbine are frequently subject to the same contracting requirements as the developers of 500 MW cogeneration facilities
- There will NEVER be a mass market for small-scale renewables if consumers need an attorney and a consulting engineer to negotiate contracts with utilities
- The cost of negotiating and establishing interconnection needs to be commensurate with the size and type of generating facility
- Regulators and legislators recently have started recognizing the need for simplified, standardized contracts for small facilities

Questions of Scale

- A 2 MW fuel cell operating as baseload generates about 1.5 million kWh per month, worth approximately $75,000 per month assuming it offsets incremental energy costs of $0.05 per kWh
- A 600 Watt solar photovoltaic system generates about 80 kWh per month, worth approximately $5 to $10 per month assuming it offsets retail purchases at $0.06 - $0.12 per kWh
- Which can afford $3,000 in interconnection costs?
- Which can afford $100/kW-yr in standby/backup charges?

Interconnection Agreements

- Regulators and legislators recently have started recognizing the need for simplified, standardized contracts for small facilities
- The Rhode Island "one-pager" was the leading model, which others (including MSRI) have now emulated
- SEPA Policy Statement on Interconnection includes model PV interconnection agreements
- MSRI has developed the latest model PV interconnection agreements

Insurance Requirements

- Six states have prohibited additional insurance requirements for net metered facilities (CA, MD, NV, OH, OR, and WA)
- Five other states have limited the amount of liability insurance coverage that can be required for net metered facilities (ID, NM, NY, VA, VT)
- The Texas PUC's rule on DG interconnection provided for mutual indemnification and limitation of liability (e.g. each party assumes liability for its own acts, and agrees to reimburse the other party for liability arising from its own acts), but the PUC rejected additional insurance requirements

Interconnection Studies

- Another issue that is emerging in the context of DG rules is the requirement that customers pay for interconnection studies to determine the effect (if any) of the DG facility on the utility distribution system.
- These interconnection studies can be expensive, and could create a substantial additional barrier for small RE systems.
- EX: In New York, RE systems over 15 kW will pay a $350 application fee, plus the cost of a "coordinated interconnection review," plus the cost of any equipment the utility concludes from the review is necessary to provide additional protection for its system, plus an annual payment of 10% of the cost of the equipment as an O&M charge.

Fees & Charges for Interconnection and Operation

- Fees and charges should be commensurate with the size and scale of the generating facility, but they are not.
- In some cases, fees may completely wipe out energy savings associated with a small PV or wind system.
- Fees include:
  - Permitting fees
  - Interconnection-related fees
  - Additional operating charges (fixed or variable), including additional metering charges and 'standby' charges
  - Competitive transition charges that discourage self-generation

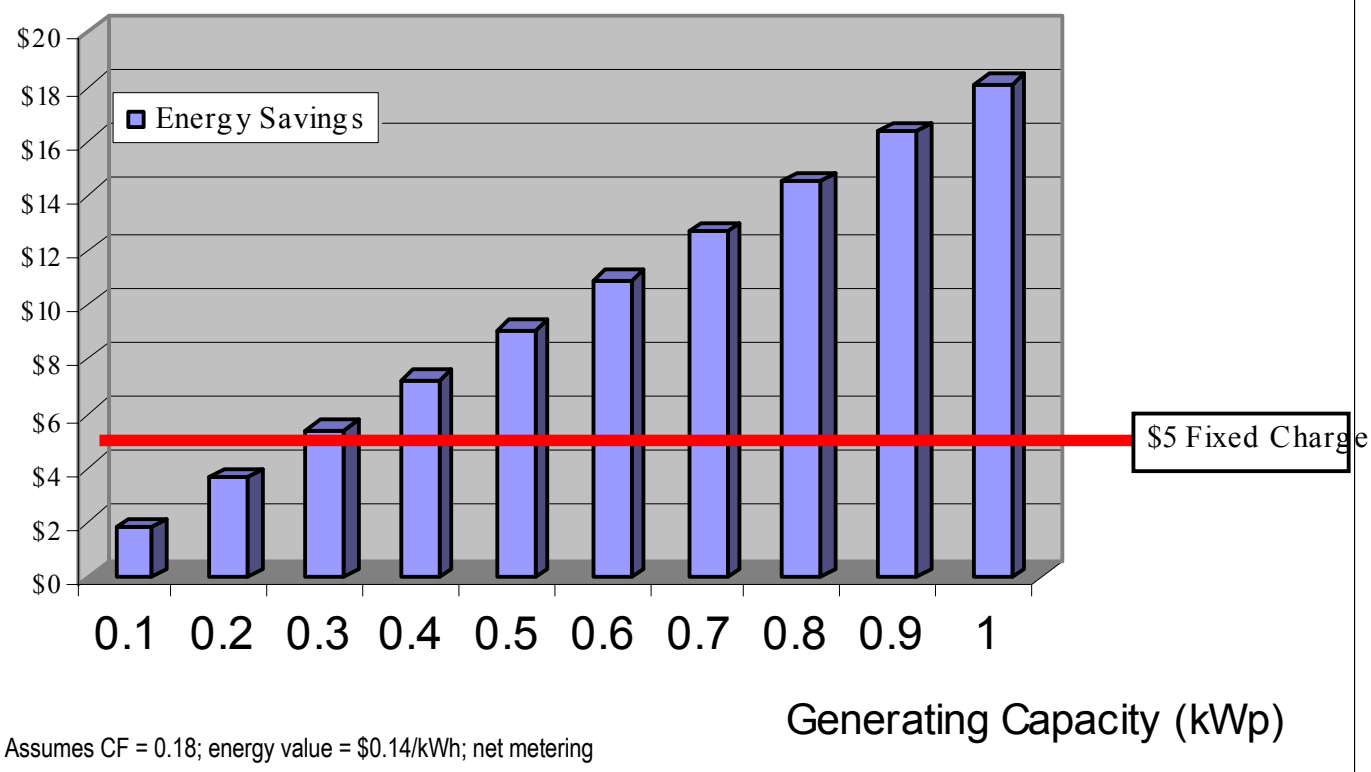
Applicability of Fees and Charges

- Most net metering laws prohibit additional fees and charges, such as interconnection fees and backup or standby charges.
- Facilities *not* eligible for net metering, however, are often subject to these additional fees and charges.
- States are now starting to address these issues in the context of developing standardized interconnection requirements for DG resources. *These rules will shape the future market for grid-tied systems,* other than those systems eligible for net metering.

Effect of Fees and Charges

- From NREL's *Making Connections* Report:
- Pennsylvania consumer wins *free* 300-Watt "SunSine" PV system!
- System will produce approximately 400 kWh per year, worth about $40 per year
- Utility imposes a $100 "application fee" for interconnection, plus a "processing/inspection fee" of up to $300
- These fees combined completely offset approximately 10 years worth of anticipated energy savings!

Impacts of Monthly Charges



Utility Interconnection Planning

- Contact the utility well in advance.
- Become familiar with the terms and conditions for interconnecting.
- Always be courteous when working with utility or inspection personnel -- They have a lot of control over the destiny of the project and they are usually very well trained on the issues!

Conclusions

- Technical requirements for interconnection need to be uniform.
- Costs of interconnection need to be minimized.
- Interconnection agreements need to be simplified.
- Fees and charges for interconnection and operation need to be commensurate with the size and complexity of the generating facility.